APPLICATION UNDER UNITED STATES PATENT LAWS

Invention: **POCKET SPEAKERPHONE**

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<u>This is a</u>:

[ ] Provisional Application

[X] Regular Utility Application

[ ] Continuing Application

[ ] PCT National Phase Application

[ ] Design Application

[ ] Reissue Application

[ ] Plant Application

SPECIFICATION

POCKET SPEAKERPHONE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to speakerphones. More particularly, it relates to a portable speakerphone device which connects to the handset jack of a standard telephone device, thus converting the standard telephone device into a speakerphone.

2. Background of Related Art

Speakerphones have become an important part of telecommunications, allowing hands free operation of a telephone after a call has been made or received. Speakerphones take many shapes and forms, including as a land line telephone or as a hands free wireless or cellular telephone. The present invention relates to the temporary conversion of a landline telephone into a speakerphone.

Conventionally, speakerphones include the ability to converse either in a common telephone mode using an attached handset or, with the handset in a cradled position, using a microphone and speaker. Typically, the microphone and loudspeaker allow a person to speak and listen on a telephone call from distances anywhere from just a few feet to dozens of feet away from the speakerphone.

As is known, sounds output from the loudspeaker of a speakerphone can cause an open loop feedback problem into the microphone unless suppressed or eliminated, or unless operated in a half-duplex mode.

Conventionally, in a full-duplex mode, the effects of any feedback from the loudspeaker to the microphone are suppressed using a conventional audio echo canceller (AEC). An AEC suppresses or eliminates from the signal received from the microphone a representation

of the signal going to the speaker. A delay mechanism in the AEC provides a delay in the suppression of the loudspeaker output from the microphone signal until the approximate time at which the sound travels to the microphone. Thus, the AEC takes into account the time it takes for sound to travel to the microphone.

One distance relevant to the audio echo canceller is the physical distance between the loudspeaker and microphone on the speakerphone. Other distances relate to the larger distances corresponding to echoes from the loudspeaker off of walls and/or the ceiling and back to the microphone.

Audio echo cancelers initially were constructed with analog components. More recently, digital algorithms operating in a processor such as a digital signal processor (DSP) have become more commonplace.

Fig. 6 depicts a block diagram of an exemplary conventional speakerphone **502**.

In particular, the speakerphone **502** includes a hybrid or telephone line interface (TLI) **514**, codecs **512**, **560**, and an audio echo canceller **592**. The speakerphone **502** typically also includes a hybrid echo canceller (not shown) to cancel reflections caused by the TLI **514**. The HEC algorithm may be included in the same DSP as the AEC algorithm.

Signals received from the central office **13** over the telephone line **506** are digitized by the codec **512**. Feedback related audio signals are suppressed or eliminated by the AEC **592**. The AEC helps prevent the possibility that feedback of audio from the loudspeaker to the microphone would cause undesirable squealing and other uncomfortable noise. Thus, the AEC algorithm minimizes acoustic feedback. The AEC algorithm may be an adaptive, speech trained

acoustic echo canceller, and is typically under the control of a host processor.

The codec **590** converts the audio (and hybrid) echo suppressed signals back into analog signals for output by the loudspeaker **212**. Similarly, signals received from the microphone **214** are digitized by the codec **560**, and buffered in the AEC **592** for use, e.g., in the adaptive suppression of echoes. The digital signals are converted back into analog signals by the codec **512**, and transmitted by the TLI **514** over the telephone line **506** directly to the central office **13**.

In operation, a signal is received from the telephone line **506** via the hybrid or telephone line interface (TLI) **514** and codec **512**. An analog-to-digital converter within a DSP implementing the AEC **592** and HEC (not shown) can be used to replace the codec **512** shown in Fig. 6 in cost sensitive applications.

The DSP forming the AEC **592** may be a dedicated processor or may double as a host processor. Alternatively, a separate microcontroller, microprocessor, or other processor may serve as a host processor for the speakerphone **502**. The amount of acoustic echo cancellation provided by the AEC algorithm may be monitored by the DSP and adjusted as necessary for optimal performance of the speakerphone **502**.

Fig. 7 shows a typical use of a conventional speakerphone **502** such as that shown in Fig. 6.

In particular, a speakerphone **502** is connected directly to a central office **13** via a telephone line **506**. Other, common telephones **500** may be connected to the same telephone line **506** or to a different telephone line to the central office **13**. When a user at the common telephone **500** requires use of a speakerphone, they must locate and utilize the speakerphone **502**. There is no conventional technique or apparatus to allow use of the common telephone **500** as a speakerphone.

Speakerphones, while commonplace, are not always conveniently located. For instance, many hotel rooms include only a common telephone. Unfortunately, situations arise where it would be convenient to have access to a speakerphone. For instance, whenever two or more persons would like to speak on a common telephone. Unfortunately, in such a case, the users either must use separate telephones, typically located on separate extensions in separate rooms, or must temporarily install an entire speakerphone **502** at the desired location. Neither solution is optimal.

There is thus a need for a convenient technique and apparatus for temporarily adapting a conventional common telephone as a speakerphone on an as needed basis.

SUMMARY OF THE INVENTION

In accordance with the principles of the present invention, an apparatus to adapt a common telephone for operation as a speakerphone comprises a loudspeaker and a microphone. An audio module is adapted for removable interface to a handset jack of a base unit of a common telephone.

A method of converting a common telephone into a speakerphone in accordance with the principles of the present invention comprises removing a handset connection between a handset and a base of the common telephone, and temporarily connecting a loudspeaker and a microphone to the handset connection on the base.

BRIEF DESCRIPTION OF THE DRAWINGS

Features and advantages of the present invention will become apparent to those skilled in the art from the following description with reference to the drawings, in which:

Fig. 1 shows a pocket speakerphone for use with the base of a conventional common telephone, in accordance with the principles of the present invention.

Fig. 2 shows a block diagram of the pocket speakerphone shown in Fig. 1.

Fig. 3 shows another embodiment of a pocket speakerphone in accordance with the principles of the present invention.

Fig. 4 shows a block diagram of the pocket speakerphone shown in Fig. 3.

Fig. 5 shows another embodiment of a pocket speakerphone wherein a voice pager is used to provide a speakerphone output.

Fig. 6 depicts a block diagram of a conventional speakerphone.

Fig. 7 shows both a conventional speakerphone and a common telephone in connection with a central office.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

The present invention provides a pocket speakerphone adapter for a landline-based common telephone to provide the common telephone with speakerphone capabilities. The pocket speakerphone is plugged into the handset jack of a conventional base unit of the common telephone, and the conventional common telephone base unit provides interconnection with the public switched telephone network (PSTN).

Fig. 1 shows a first embodiment of a pocket speakerphone **100** in accordance with the principles of the present invention.

In particular, Fig. 1 shows a pocket speakerphone **100** interconnected with the base unit **500a** of a common telephone **500a**. In the preferred embodiment, the handset **500b** of the conventional common telephone **500** is disconnected from the handset jack **500j** of the base unit **500a**, and the pocket speakerphone **100** is connected in its place to the

handset jack of the base unit **500a** using a conventional handset cord **508**.

The base unit **500a** is connected to the central office **13** over a conventional telephone line **506**, and is responsible for providing the proper impedance on the telephone line **506**, e.g., both in an on-hook condition and in an off-hook condition.

In the first embodiment as shown in Fig. 1, the handset **500b** of the common telephone **500** is preferably replaced with the pocket speakerphone **100**, and therefore the handset **500b** is set aside and unused while the pocket speakerphone **100** is in use.

The pocket speakerphone **100** includes a loudspeaker **212** and a microphone **214**, and suitable amplifiers to provide levels of audio input and output in accordance with the needs of the particular application. The specific loudspeaker **212**, microphone **214** and amplifiers used in the pocket speakerphone **100** are the same as those used in conventional speakerphone devices.

The disclosed embodiment is a small, pocket-sized speakerphone **100**. Preferably, to minimize size and cost, the pocket speakerphone **100** provides only essential functions of a speakerphone to allow hands free operation of a land line telephone. However, other speakerphone features and/or components may be included within the principles of the present invention so long as the pocket speakerphone **100** remains temporarily adaptable for connection with the handset jack **500j** of the base unit **500a** of a common telephone **500**.

Importantly, as can be seen in Fig. 1, the pocket speakerphone **100** connects to the handset jack **500j** of the conventional common telephone and not directly to the telephone line **506**. This off-loads the responsibility to the base unit of the common telephone **500** for providing proper impedance to the central office **13** over the telephone line **506**.

The pocket speakerphone **100** need not include a telephone line interface (TLI) or similar circuit to provide the proper AC and DC levels to the telephone line **506**. Instead, the base unit **500a** of the common telephone **500** includes a conventional TLI which is responsible for providing the proper impedance to the telephone line **506**. Nevertheless, the pocket speakerphone **100** may include a TLI if desirable to provide electrical isolation.

Fig. 2 is a block diagram showing an implementation of the first embodiment of a pocket speakerphone **100** as shown in Fig. 1.

In particular, the pocket speakerphone **100** includes the loudspeaker **212** and microphone **214** and a suitable audio module **248** to drive the loudspeaker **212** with the signals received from the handset jack **500j** of the base unit **500a** (Fig. 1), and to receive and amplify as necessary the signals input to the microphone **214**.

The audio module **248** may be digital based as shown in the disclosed embodiments, or it may be analog based. In the digital based audio module **248** shown in Fig. 2, codecs **208**, **202** convert the analog signal from the handset jack **500j** of the base unit **500a** to digital signals for processing, e.g., for audio echo cancellation (and for hybrid echo cancellation if a TLI is used in the pocket speakerphone **100**) by suitable algorithms in an appropriate processor such as a DSP, and back again to analog signals.

Moreover, the audio module **248** may be either full-duplex or half-duplex. If the audio module **248** of the pocket speakerphone **100** is full-duplex, the AEC **206** is required to suppress or eliminate undesirable feedback from the loudspeaker to the microphone input. If, on the other hand, the audio module **248** is half-duplex, the AEC **206** itself may be eliminated. In the half-duplex mode of operation, the pocket speakerphone **100** is either receiving input sounds through the microphone **214** above a certain threshold level, or outputting signals

received from the telephone line **506** through the loudspeaker **212**. The direction of the operation of the pocket speakerphone **100** with a half-duplex audio module **248** is determined based on an audio level detected by the microphone **214** in ways well known in the art.

The pocket speakerphone **100** includes a power supply **210** sufficient for providing all necessary power to the audio module **248** and any other necessary functions. The power supply **210** is preferably battery power to provide maximum portability, but may instead convert any suitable external source of DC or AC power into the DC voltage necessary to operate the audio module **248**, e.g., into 3 or 4 volts DC.

Fig. 3 shows a second embodiment of a pocket speakerphone 100a in accordance with the principles of the present invention. This second embodiment intercepts the signal between the conventional based unit **500a** and handset **500b** and provides switchable operation of the pocket speakerphone **100a**.

In particular, the second embodiment of the pocket speakerphone **100a** is similar to that shown in Figs. 1 and 2 but for the addition of a switch function **302** to allow use of either the handset **500b** of the common telephone **500** or the speakerphone functionality provided by the pocket speakerphone **100a**.

Although the switch **302** is shown in Fig. 3 as a mechanical or electrical switch, it is to be understood that the switch **302** represents any electrical or mechanical apparatus which provides switchability in the signal to the handset jack **500j** of the base unit **500a** of the common telephone **500**. For instance, in one mode, the switch function **302** provides signals with respect to the pocket speakerphone **100** to the base unit **500a**. In another mode, the switch function **302** provides conventional functionality by connecting the handset **500b** directly to the base unit **500a**.

The switch function **302** may be operable by a physical placement of a component of the common telephone **500**. For instance, the switch function **302** may be caused to connect the pocket speakerphone **100a** to the handset jack **500j** of the base unit **500a** when the base unit **500a** is in an off-hook condition and the handset **500b** is rested in a predetermined location, e.g., in the on-hook cradle. Preferably, before placing the handset **500b** on the cradle, the user will depress a key on a keypad of the base unit **500a** indicating that the placement of the handset **500b** in the cradle is not to cause an on-hook condition.

Fig. 4 is similar to Fig. 2, but additionally shows the switch function **302** in more detail.

In particular, the switch function **302** is a double pole, double throw (DPDT) type switching function having two positions or modes. In a first position or mode **A**, the audio module **248** is electrically connected to the handset cord **508** to the handset jack **500j** of the base unit **500a**. In a second position or mode **B**, the conventional handset **500b** is connected directly to the handset cord **508** and handset jack **500j** of the base unit **500a** to provide conventional common telephone functionality.

Fig. 5 shows another embodiment of a pocket speakerphone 700 comprised of an otherwise conventional voice pager together with speakerphone capabilities. In particular, the pocket speakerphone 700 includes a conventional paging display 702 for displaying conventional paging messages, and a speaker 712 for playing voice pages. However, in addition to the conventional components of a voice pager, the pocket speakerphone 700 in this embodiment includes a microphone 714 for use with the speakerphone operability. Moreover, the speaker 712 and appropriate amplifiers are also used in the pocket speakerphone mode for outputting the audio signal on a telephone line 506 when connected in place of the handset 500b of a conventional telephone 500a.

When not connected to the telephone **500a**, the pocket speakerphone **700** operates as a conventional voice pager. However, upon connection to the handset cord **508**, the pocket speakerphone **700** enters a speakerphone mode which presents audio input to the microphone **704** to the handset cord **508**, and which plays audio from the handset cord **508** on the speaker **712**.

Of course, a controller in the pocket speakerphone **700** preferably includes an appropriate audio echo canceler (AEC) for suppressing or eliminating any echoes or other undesirable feedback from the walls or furniture in the room in which the pocket speakerphone **700** is temporarily installed.

While the disclosed embodiment relates to a digital speakerphone **100**, the present invention is equally applicable to analog speakerphones.

While the invention has been described with reference to the exemplary preferred embodiments thereof, those skilled in the art will be able to make various modifications to the described embodiments of the invention without departing from the true spirit and scope of the invention.